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EXAMINER	
BLOOM, NATHAN J	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/525,005	MULET PARADA ET AL.	
	Examiner	**Art Unit**	
	NATHAN BLOOM	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _28 April 2008_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-4 and 6-23_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-4 and 6-23_ is/are rejected.

7)☒ Claim(s) _21_ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _28 April 2008_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _04/28/2008_.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Applicants' response to the last Office Action, filed on April 24th, 2008 has been entered and made of record.

Response to Arguments

1. Applicant's arguments filed 04/28/2008 have been fully considered but they are not persuasive. Please see the discussion below.

2. In response to applicant's argument on page 14 (2nd-4th full paragraph) that Ladak does not teach "deriving a preliminary contour based on input points and a known average contour shape by applying a parametric model to transform a known average contour shape such that landmark points of the known average contour shape match corresponding inputs points". As per the 35 USC 103 rejection below (has been refined to further detail the rejection) Ladak has taught the use of a preliminary contour and landmark points ("features of interest" paragraph 0028) and maps the preliminary contour to the landmark points based on user input and a parametric model (paragraphs 0034-0037 and 0062) used for deformation, but did not teach the use of an average contour. However, Lobregt has taught that methods such as Ladak can use "any reasonable initial contour" to begin the deformation and contour estimation, and Cootes has taught the use of predetermined average contour to use as a preliminary contour. Thus in view of the teachings of Lobregt it would have been obvious to one of ordinary skill in the art to replace the initial contour taught by Ladak with a more accurate (and automated) preliminary contour as taught by Cootes to increase the accuracy of the initial guess (reduces amount of computation

required to further deform the contour) and to automate the process of defining the preliminary contour.

Response to Amendment

3. The amendment to claim 19 has overcome the objection made in the previous office action. Claim 19 has been treated on the merits in this action, see below.

4. The amendment to claims 20-21 have overcome the 35 USC 101 rejection made in the previous office action. However, the amendment has introduced a new issue in claim 21, see claim objection below.

5. The amendments to the Abstract, Drawing (figure 8), and the Specification received on 04/28/2008 have been entered and made of record.

Claim Objections

6. Claim 21 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 20 already requires that the program be stored upon a computer readable recording medium, thus claim 21 does not further limit claim 20.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 1-4, 6-9, 15-16, and 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ladak (US 2004/0218797) and Lobregt ("A Discrete Dynamic Contour Model") in view of Cootes ("Statistical Models of Appearance for Medical Image Analysis and Computer Vision")

Instant claim 1: A method of computing a contour comprising:

inputting a plurality of points, each input point being indicative of a predetermined landmark point in an image; [*Ladak describes a plurality of inputted points in paragraphs 0028, 0046-0048, and Figures 1, 8-11, and 13, wherein the inputted points are on the initial contour of the object (figure 1a).*]

deriving a preliminary contour based on the input points and a known average contour shape by applying a parametric model to transform the known average contour shape such that landmark points of the known average contour shape match corresponding input points; and [*Ladak in paragraph 0028 teaches creating a preliminary contour based only on the input points received from the user and not a known average contour shape. However, statistical shape analysis for the purpose of calculating contours was known, as is shown by Cootes in section 1, 2, 4, and the abstract. Cootes has taught in these sections the use of training sets of images with*

corresponding landmark points to create a statistical model of the object's shape and characteristics. This statistical shape model is then used for registration and segmentation by deforming the known "average contour" based on the statistical model (also referred to as an Active Shape Model – parametric model). Ladak relies on discrete dynamic (deformable) contours for development of an actual contour from an initial contour, as is taught in further detail by Lobregt. Lobregt discloses in the final column of page 23 and in figure 15 that the discrete dynamic contour as used by Ladak can be successfully deformed based on any reasonably shaped initial contour. It would have been obvious to one of ordinary skill in the art to consider and use the teachings and motivations of Lobregt since Lobregt teaches a similar method to that of Ladak. Thus, Cootes has taught the development a known "average contour" to use as an initial contour for computation of similar contours from image, and Ladak in view of Lobregt has taught the use of any reasonable initial contour. One of ordinary skill in the art at the time of the invention would have recognized that the closer the initial contour is to that of the actual contour then the less time and computations it will take to converge to the actual contour. Therefore, it would have been obvious to one of ordinary skill in the art to combine the known methods of using and calculating an initial contour based on a known "average contour" as is taught by Cootes with a noise and image artifact robust contour computational method as taught by Ladak to reduce the computational time of the process. Thus Ladak and Lobregt in view of Cootes has taught the use of an average contour as the initial contour and then the further deformation of this contour through various stages in order to compute the actual contour of the object. Also, Ladak in paragraphs 0028-0064 discloses morphing/deforming of the contour using energy minimization parameters, force parameters, and in paragraph 0062 parameters

(parametric model to transform initial contour such that points on contour match points) based on the object to be contoured. Furthermore, Ladak has taught in paragraph 0028 the transformation of the initial contour (Ladak refers to it as an outline) to a preliminary contour (any contour after the initial and prior to the final contour) such that the contour is deformed to fit (match) the landmark points (features of interest paragraph 0028).]

deforming the preliminary contour to fit features identified in the image to obtain the computed contour. [*Ladak teaches the deformation to fit features in paragraphs 0028 and 0061-0067.*]

Instant claim 2: A method according to claim 1, wherein a total number of the input points is fewer than a number of points needed to define a shape of the computed contour. [*Ladak teaches the number of inputted points in paragraphs 0028, 0046-0048, and Figures 1, 8-11, and 13 wherein the number of points increases or decreases with each iteration as the resolution of the curve increases or decreases depending on the complexity of the calculated contour. Inherently the complexity of the contours of real world objects requires more than the minimum number of identified points to correctly describe the contour, and thus the number of inputted points is fewer than the number of points needed to define the actual contour.*]

Instant claim 3: A method according to claim 1, wherein a number of degrees of freedom defined by the input points is fewer than a number of degrees of freedom needed to define a shape of the computed contour. [*Ladak teaches a 2-D and 3-D system wherein respectively the number of degrees of freedom for a point is 2 and 3 respectively. Additionally, given that (as*

discussed in the rejection of claim 2) the number of inputted points is fewer that the final computed contour then the number of degrees of freedom is also fewer.]

Instant claim 4: A method according to claim 1, wherein the known average contour shape is obtained from a database of contours derived from previous images. [*Cootes in the abstract discloses that a set of training images is used to create the statistical model (average contour), and covers this in more detail in the remaining disclosure. Furthermore, it is inherent that the training images are stored in a database or other storage system since Cootes must retrieve them from some data storage unit to create the statistical model.*]

Instant claim 6: A method according to claim 1, wherein said deforming operation comprises deforming the preliminary contour by applying the parametric model. [*Ladak as per the rejection of claim 5 deforms (derives) the contours from the initial (preliminary) to the final contour. Furthermore, this deformation is done iteratively (paragraphs 0028, 0046, and 0061-0066) until a desired state is converged to.*]

Instant claim 7: A method according to claim 1, wherein the parametric model is a deformation model derived from a statistical shape model constructed from a database of contours derived from previous images. [*As per rejection of instant claim 1 the deformation of the contour is based on the initial contour which is the statistical shape model or known "average contour".*]

Instant claim 8: A method according to claim 1, wherein the contour represents a boundary of an item of interest in the image. [*Ladak teaches outlining an object of interest in figures 1 and 9-13, and paragraph 0067.*]

Instant claim 9: A method according to claim 1, wherein the image is an anatomical image. [*Ladak teaches outlining an object of interest in figures 1 and 9-13, and paragraph 0067.*]

Instant claim 15: A method according to claim 1, wherein a number of the input points is exactly three. [*Ladak has taught the selection of points by a user, and mentions the use of 4 points in paragraph 0048, but not three. However, this is merely an example as the method is applicable for a number of points other than the 4 that was determined to work well for the described example. See paragraph 0067 of Ladak in which the method is described as usable for segmenting images of other objects. Also, see Lobregt for further detail on the point selection method relied upon by Ladak.*]

Instant claim 16: A method according to claim 1, wherein the image is created using a modality selected from the group consisting of ultrasound, nuclear medicine, X-ray and magnetic resonance imaging. [*Ladak in paragraphs 0006-0008,0017, and 0028 teaches ultrasound.*]

Instant claim 19: A computer system comprising:

a data processor;

a data storage device;

an input device; and

a display, wherein the data processor is adapted to process data in accordance with an executable program stored in said data storage device, and the executable program is adapted to cause a computer to execute at least the method of claim 1 on data representing an image displayed on said display and using the plurality of points in the image displayed on said display input with said input device. [*Ladak, Lobregt, and Cootes clearly detail the method of performing the operations (see the rejection of claim 1), but do not detail the physical structure or the software coding. However, as is clear from the figures 1a-1d of Ladak the system has been implemented and displayed. Examiner takes official notice that it was notoriously well known to one of ordinary skill in the art to implement image processing methods on a computer system having a data processor, storage, input, and display device in order to implement and utilize the described method. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Ladak, Lobregt, and Cootes with the knowledge of one of ordinary skill in the art to implement the described digital image processing methods using the necessary digital and physical means (software on a computer system).*]

Instant claim 20: A computer program recorded on a computer-readable recording medium comprising program code for causing a computer to execute at least the method of claim 1. [*See the rejection of claim 19.*]

Instant claim 21: A computer-readable recording medium having recorded therein the computer program of claim 20. [*See the rejection of claim 19.*]

9. Claims 10-14, 17-18, and 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ladak, Lobregt, and Cootes as applied to claims 1 and 8-9 above, and further in view of McInerney ("Deformable Models in Medical Image Analysis: A Survey").

Instant claim 10: A method according to claim 9, wherein the image is an image of a heart. [*Ladak teaches the outlining of a prostate in figures 1 and 9-13, and in paragraph 0067 teaches that this method is adaptable to other organs, but does not specify the organ as a heart. (Note: McInerney presents a collection and summation of common methods of dynamic contouring various objects, and matching, measuring, tracking the contours of these objects using models, templates, a priori knowledge of the shapes through statistical analysis, and various other segmentation techniques.) However, McInerney in the 3rd full paragraph of page 10 and 11 teaches using statistical models to guide deformable contours to find, segment, and measure the heart by its contours. It would have been obvious to one of ordinary skill in the art to combine the teachings of McInerney with Ladak to use the robust contouring and segmentation method as taught by Ladak on the images of a heart. Ladak teaches a method which as stated in paragraph 0006 is robust to noise and artifacts, and thus would have been advantageous to use with images of any organs capable of being imaged by methods known at the time of the invention.*]

Instant claim 11: A method according to claim 10, wherein the image is a long-axis view of a heart. [*Ladak in view of McInerney do not teach the heart image being a long-axis view of the heart, but are not limited to any particular view as they are applicable to any view of the heart*

that is segmentable by the method described by Ladak. Therefore, Ladak in view of McInerney teaches the long-axis view.]

Instant claim 12: A method according to claim 10, wherein the contour represents an endocardial boundary of a left ventricle of the heart. [*McInerney in section 3.5 teaches the contouring of the endocardial boundary of the left ventricle of the heart.*]

Instant claim 13: A method according to claim 12, further comprising calculating the volume of a left ventricle. [*Ladak teaches in paragraph 0005 that the contouring is used to measure the volume of the organ, but does not specify the volume measurement of the heart's left ventricle. In view of the rejection of claims 10-12 and the disclosure of motion tracking and measurement of the left ventricle of the heart by McInerney in section 3.5 the measurement of the volume of the left ventricle based on calculated contours was known to one of ordinary skill in the art at the time of the invention. Furthermore, the use of any well known and accurate contour computing method, such as the method taught by Ladak, to create the contours for calculation of the volume would have been obvious to one of ordinary skill in the art.*]

Instant claim 14: A method according to claim 1, wherein the predetermined landmark points in the image comprise:

a root of a left mitral valve leaflet;

an apex of a left ventricle; and

a root of a right mitral valve leaflet. [*Ladak teaches outlining an anatomical object of interest in figures 1 and 9-13, and paragraph 0067, and as per rejection of claims 10-13 the use of the heart as the object of interest was known to one of ordinary skill in the art. Also, Ladak teaches the selection of the points by the user, but does not teach the selection of points of interest. However, Examiner takes official notice that it was notoriously well known to one of ordinary skill in the art to select points of high interest for increased accuracy of the segmentation and measurement of the organ with respect to these points.*]

Instant claim 22: A method according to claim 11, wherein the contour represents an endocardial boundary of a left ventricle of the heart. [*See rejection of claim 12.*]

Instant claim 23: A method according to claim 22, further comprising calculating a volume of the left ventricle. [*See rejection of claims 22 and 12-13.*]

Instant claim 17: A method of computing the motion of a contour, for a temporal sequence of images of a subject, said method comprising:

computing the contour for one image of the sequence of images according to the method of claim 1; [*As shown in the rejection of claims 1-16 these methods have been taught.*]

using the computed contour as a new preliminary contour for a further image in the sequence of images; [*McInerney teaches in paragraph 3 of pages 10 and 11 the use of a priori knowledge in the computation of a new contour. Furthermore, as per the rejection of instant*

claim 1 it would have been obvious to one of ordinary skill in the art to use an initial contour that is similar to that of the actual contour.]

deforming the new preliminary contour to fit features identified in the further image to obtain a computed contour for the further image; and [*As per rejection of claims 1-9 Ladak teaches the deformation of the preliminary contour to fit features of the image and to converge upon an approximation of the actual contour.*]

repeating said using and deforming operations to obtain a computed contour for each image in the sequence of images. [*The sequential deformation of images to identify motion and volumetric measurements using dynamic contours was well established as is discussed by McInerney in section 3.5. Furthermore, it would have been obvious to use the contouring method as taught by Ladak and Lobregt in view Cootes to deform a series of images with a reasonable expectation of success.*]

Instant claim 18: A method according to claim 17, wherein the computed contours represent an endocardial boundary of a left ventricle of a heart, said method further comprising:

calculating left ventricle volumes from the computed contours; and [*See rejection of claims 12-13 and 22-23.*]

using the calculated volumes to calculate at least one of the stroke volume and ejection fraction of the heart. [*See section 3.1 of McInerney wherein it teaches that measurement of the ejection fraction of the heart is a common measurement taken from heart segmentation images.*]

Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nathan Bloom whose telephone number is 571-272-9321. The examiner can normally be reached on Monday through Friday from 8:30 am to 5:00 pm (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mehta Bhavesh, can be reached on 571-272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Brian Q Le/

Primary Examiner, Art Unit 2624